

Permeable Pavements 101

Porous Pavements for Cool Cities?

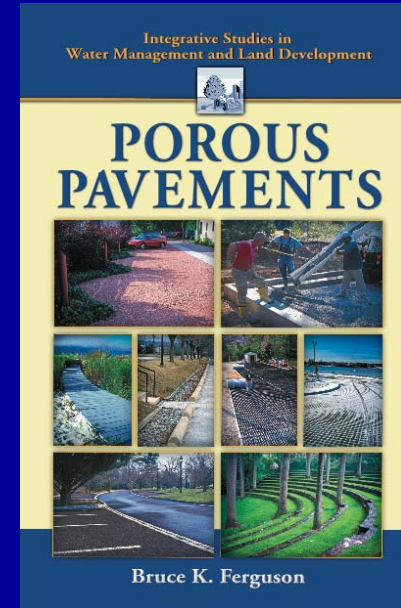
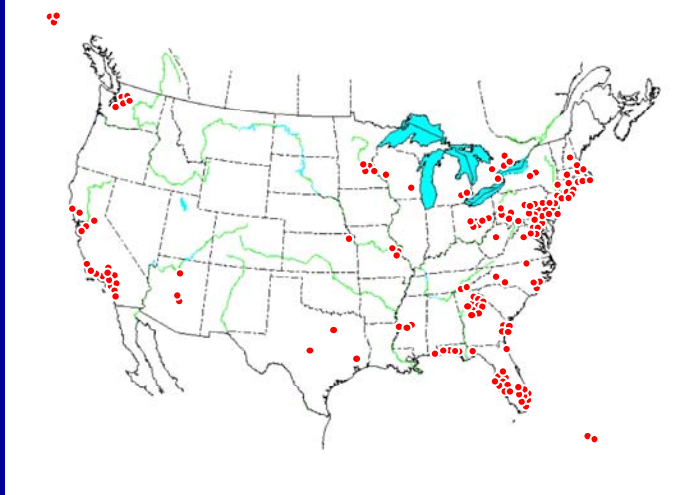
Bruce K. Ferguson
EPA Cool Pavements
June 27, 2005

The potentials

- Clean water
- Long-lived trees
- Cool cities
- Quiet streets, Safe driving
- Beauty
- Preservation of native ecosystems
- Cost reduction

Eight years of research

- 170 interviews
- 800 technical articles & reports
- 280 installations in the field



Questions are numerous & detailed

But how about...

- Slowly permeable soil?
- Compaction?
- Clogging?

Therefore:

- I cannot cover all the technical questions today
- The book has 577 pages

To make a successful pavement

- Select it right
- Design it right
- Build it right
- Maintain it right

Eight families of porous materials

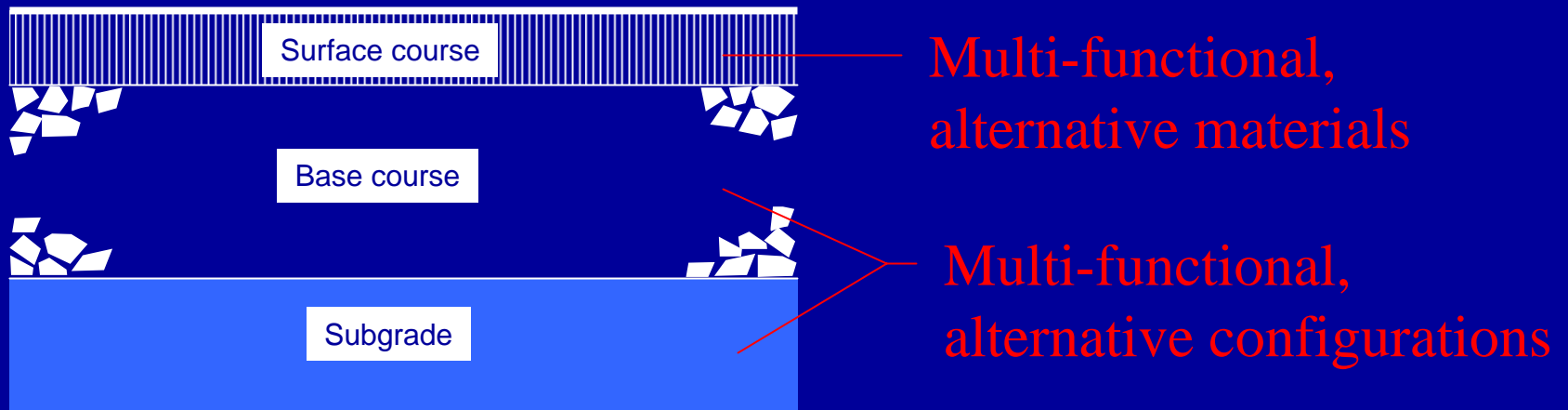
Each material has its own:

- Maintenance requirements
- Cost
- Installation methods
- Performance levels
- Advantages & disadvantages for specific applications

Alternative porous materials

- Porous aggregate
 - Inexpensive & very permeable
- Porous turf
 - Living & dynamic
- Plastic geocells
 - Recycled
- Open blocks & grids
 - Sturdy, attractive, & reliable
- Porous concrete
 - Quality depends on installer
- Porous asphalt
 - Technology advancing
- “Soft” materials
 - Organic & recycled
- Decks
 - Adaptive to site

Generic pavement components

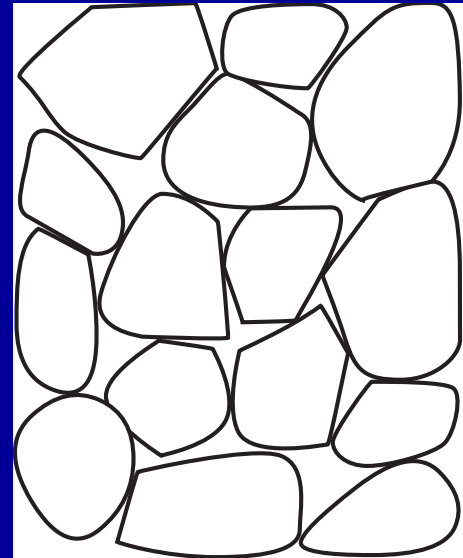


Aggregate is the most ubiquitous component

“Open-graded” (single-sized)

Narrow range of sizes with little or no fines

- Open voids between particles
- 30-40% porosity
- Permeability 1,000 in/hr+
- Well drained, nonplastic
- Stability from angular interlock
- No dust



Thermal Effect 1:
Evapotranspirative cooling

Grass “pavement” surface:
18°F cooler than dense asphalt (noon, clear day)
— Asaeda & Ca, 2000



— Orange Bowl Stadium, FL

Thermal Effect 2:
Effective tree shading

Rooting space:

As large as mature canopy, or trees can die in 7 years



*“Structural soil”
base-course rooting zone*



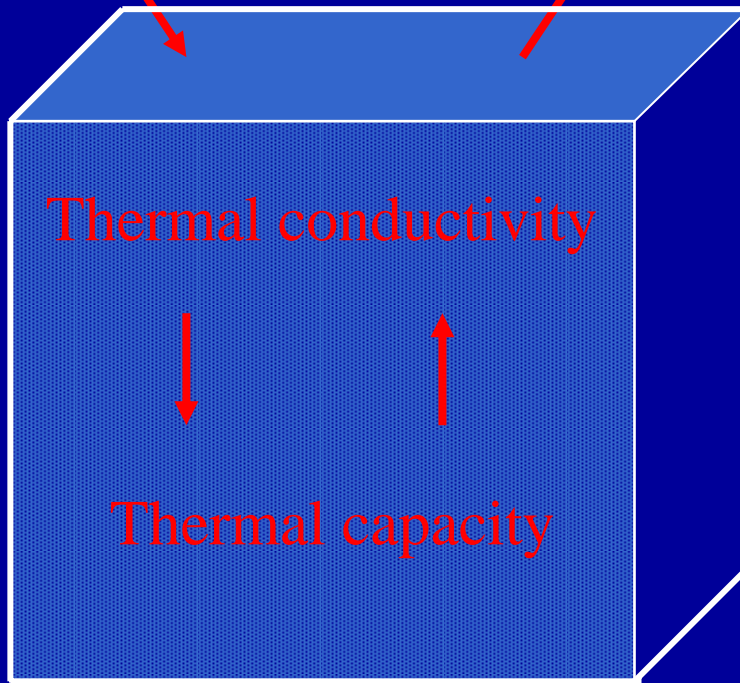
*Porous surface
admits air & water*

Thermal effect 3:

Can porosity per se reduce heat island?

Day heat in

Evening heat out



Porous material should have lower conductivity

Porous material should have lower capacity

Observation in Japan:

Light-colored, highly porous concrete block surface:

- Same high temperature as dense asphalt,
all day & night

— *Asaeda & Ca, 2000*

Observation in Ontario:

Light-colored open-jointed concrete blocks:

- Cooler than dense asphalt during day
- Warmer at night

— *James & Thompson, 1996*

These were surprising results:

- Could color be less important than we thought?
- Could worn asphalt be as reflective as concrete?
- Could air movement through pores counteract porous material's low conductivity & capacity?
- Could either study have been flawed?

Research is needed:

To contrast porous & nonporous materials'
thermal behavior

